(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 461 669 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91109798.8**

(51) Int. Cl.5: **G02B 23/26**, A61B 1/00

(22) Date of filing: **14.06.91**

(30) Priority: **15.06.90 JP 62702/90**

(43) Date of publication of application:
18.12.91 Bulletin 91/51

(84) Designated Contracting States:
DE FR GB

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(54) Structure of rod lens for endoscopes.

(57) A red lens structure comprises, an inner tube (1) having a relay lens (2) inserted therein, an outer tube (8) mounted around an outer periphery of the inner tube in concentric relation thereto with a predetermined gap, and light transmitting device (9), for guiding illumination light to the distal end of the rod lens, provided axially between the inner tube and the outer tube.

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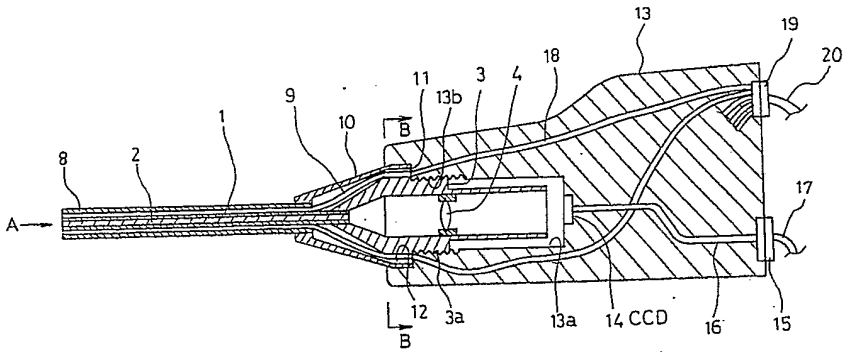

Fig. 1

This invention relates to the structure of a needle-type lens for observing a living body.

A conventional needle-type lens for observing the interior of a living body is constructed as shown in Figs. 4 to 6. In these Figures, a relay lens 2 of a bar-like shape is inserted in an inner tube 1, and a support member 3 of a generally cylindrical shape is mounted on one end of the inner tube 1. An ocular lens 4 is mounted within the support member 3, and is disposed on the optical axis of the relay lens 2. A solid charge-coupled device (CCD) (not shown) is connected to the end of the support member 3 remote from the end thereof on which the inner tube 1 is mounted. A funnel-shaped condenser guide 5 made of an acrylic resin is mounted on the outer periphery of the inner tube 1 in intimate contact therewith. The proximal end portion of this condenser guide is increasing in diameter, and fits on the outer periphery of the support member 3, and is fixed thereto by a plurality of fixing screws 6.

In the needle-type lens 7 of the above construction, its distal end is inserted into a portion of a living body to be observed, and light emitted from a light source (not shown) is applied via the condenser guide 5 to the portion to be observed, and an image of the observed portion is projected onto the CCD in a magnified manner through the relay lens 2 and the ocular lens 4. The image projected on the CCD is converted into an electrical signal, and is displayed on a display device via a processing circuit.

In the conventional needle-type lens structure of the above construction, however, it is difficult to manufacture the condenser guide 5, because it is formed into an elongated tubular shape, using an acrylic resin, and besides the surface of this condenser guide can be easily damaged, which results in a problem that light leaks through such damaged portion. The condenser guide has further drawbacks that it is deformed upon lapse of time and that it is corroded by chemicals. As a result, there is a risk that the portion to be observed can not be illuminated sufficiently.

As described above, in the conventional needle-type lens structure, it is difficult to manufacture the condenser guide, because it is formed into an elongated tubular shape, using an acrylic resin, and besides the condenser guide can be damaged at its surface, and is corroded by chemicals and is deformed. As a result, there is encountered the problem that a sufficient illumination can not be provided.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above problems, and an object of the invention is to provide a needle-type lens structure which can be easily manufactured, and is excellent in durability, and can sufficiently illuminate the portion to be observed.

The above object has been achieved by a needle-type lens attached to an image pickup probe which has a charge-coupled device provided at a central portion, and a light guide member provided around said charge-coupled device and opens to one end face; CHARACTERIZED in that said light guide member is constituted by a plurality of light-transmitting fibers; said needle-type lens is constituted by an inner tube having a relay lens inserted therein, an outer tube fixedly mounted around an outer periphery of said inner tube in concentric relation thereto, and said plurality of light-transmitting fibers provided axially between said inner tube and said outer tube so as to guide illumination light to the distal end of said needle-type lens; the proximal end of said outer tube is increased in diameter and is connected to the end face of said probe; and the light-transmitting fibers on the side of said probe are communicated respectively with the light-transmitting fibers on the needle-type lens at their connection ends.

In the above construction, light from a light source is applied via the optical fibers to a portion to be observed, and therefore this portion can be sufficiently illuminated. And besides, since the optical fibers are protected by the outer tube, the durability is enhanced.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a vertical cross-sectional view of one preferred embodiment of a needle-type lens structure of the present invention;

Figs. 2 and 3 are views as viewed from arrows A and B of Fig. 1, respectively;

Fig. 4 is a vertical cross-sectional view of a conventional needle-type lens structure; and

Figs. 5 and 6 are views as viewed from arrows A and B of Fig. 4, respectively.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

One preferred embodiment of the invention will now be described with reference to the drawings.

Figs. 1 to 3 shows one preferred embodiment of the invention. Those portions of these Figures identical to or corresponding to those of the prior art of Figs. 4 to 6 are designated by identical reference numerals, respectively, and explanation thereof will be omitted.

Features of this embodiment are that an outer tube 8 is mounted around an outer periphery of an inner tube 1 (in which a relay lens (bar-shaped

lens) 2 is inserted) in concentric relation thereto, with a predetermined gap provided therebetween, and that a plurality of optical fibers 9 are inserted axially through the space between the inner tube 1 and the outer tube 8. The proximal end of the outer tube 8 is fixedly secured to a support member 3 through a cover 10 of a generally conical shape. A flange portion 11 is provided at the portion of connection between the support member 3 and the cover 10, and a plurality of (for example, eight) parallel through holes 12 are formed axially through the flange portion 11 at equal intervals. Eight optical fibers 9 are passed respectively through the through holes 12 into the space between the inner tube 1 and the outer tube 8. The distal ends of the optical fibers 9 are open to the distal ends of the inner and outer tubes 1 and 8. The eight optical fibers 9 extended from the through holes 12 in the flange portion 11 are bundled together, and are connected to a light source (not shown). The inner tube 1, the outer tube 8, the support member 3 and the cover 10 are all made of stainless steel.

In this embodiment, light emitted from the light source passes through the optical fibers 9, and efficiently illuminates a portion of a living body to be observed against which portion the distal ends of the inner and outer tubes 1 and 8 are abutted. Since the inner tube 1 and the outer tube 8 are made of stainless steel, these tubes each having a small diameter and a long axial length can be precisely manufactured. Further, since the optical fibers 9 are covered with the outer tube 8, the optical fibers 9 are prevented from damage, corrosion, deformation and etc.

In the above embodiment, although the various parts are made of stainless steel, this material is not limited to stainless steel. The number of the optical fibers 9, as well as the number of the through holes 12, is not limited to eight.

As described above, in the present invention, the needle-type lens is constituted by the inner tube and the outer tube, and the optical fibers are inserted through the space between the two tubes. Therefore, this structure can be manufactured easily and precisely, and its durability is enhanced, and the portion to be observed can be sufficiently illuminated.

Claims

1. A needle type lens structure comprising:
   an inner tube having a relay lens inserted therein;
   an outer tube mounted around an outer periphery of said inner tube in concentric relation thereto with a predetermined gap; and
   light transmitting means, for guiding illumination light to the distal end of said needle type lens, provided axially between said inner tube and said outer tube.

2. A needle type lens as claimed in claim 1, further comprising:
   a image pick up probe having:
   a charge-coupled device provided at a central portion;
   a light guide member provided around said charge coupled device and opening to one end face;
   an ocular lens disposed on the optical axis of said relay lens; and
   a conical shape cover connecting the proximal end of said outer tube to said probe.

3. A needle type lens as claimed in claim 2, wherein the proximal end of said inner tube is connected to said end face of said probe.

4. A needle type lens as claimed in claim 3, wherein said light transmitting means includes a plurality of light transmitting fibers.

5. A needle type lens as claimed in claim 3, wherein said light transmitting means is communicated between the said probe and said cover.

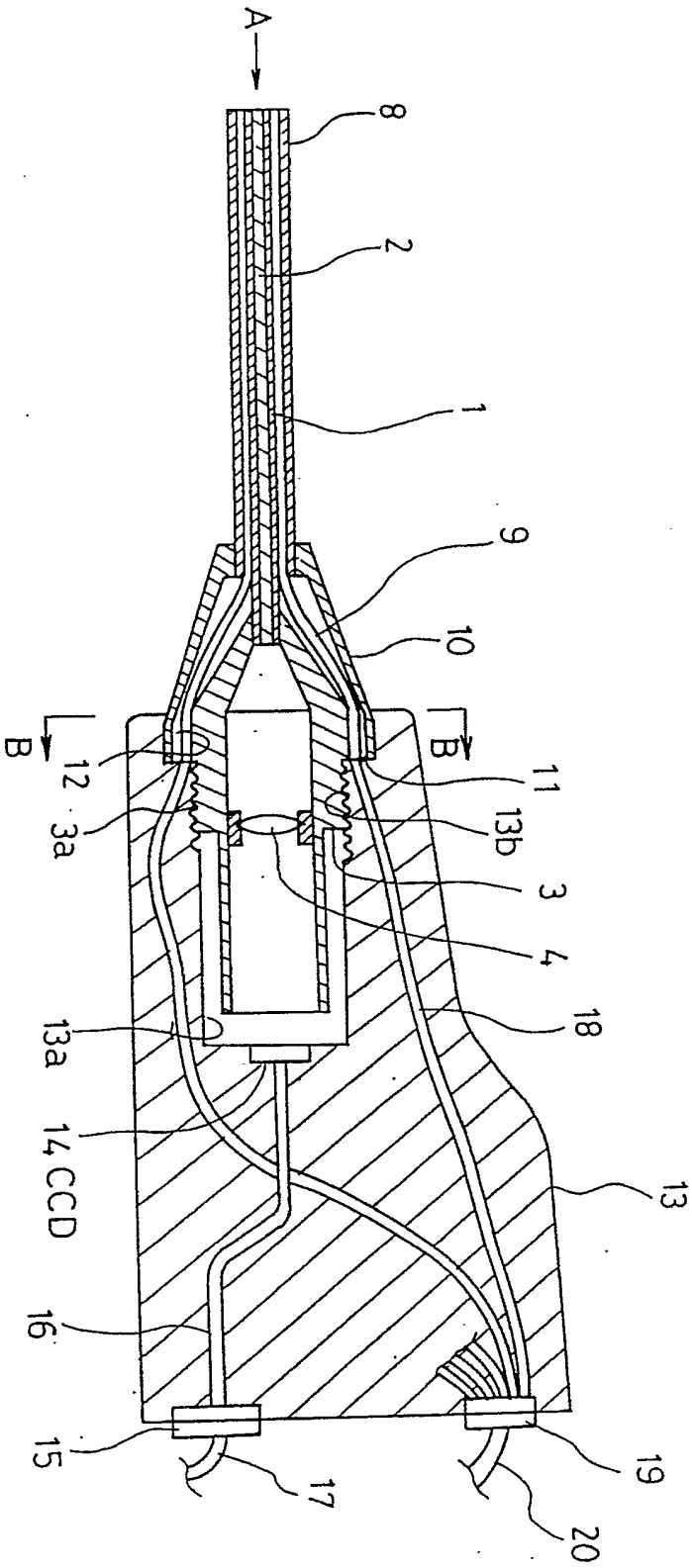

Fig. 1

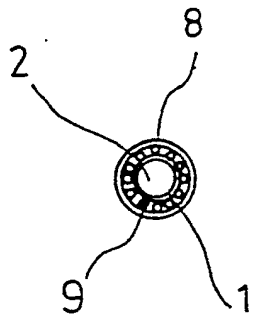

Fig. 2

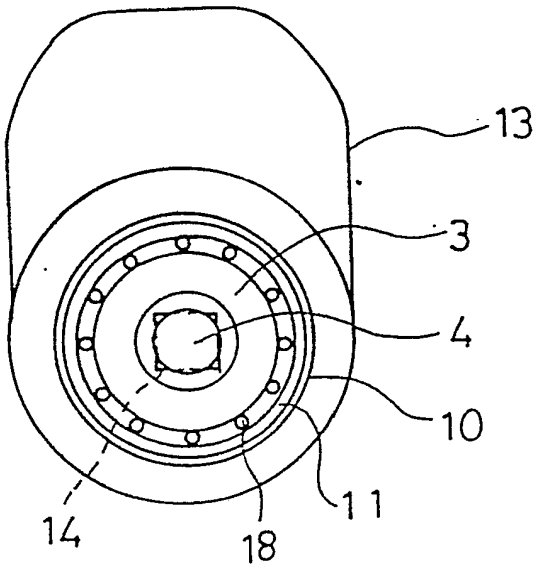

Fig. 3

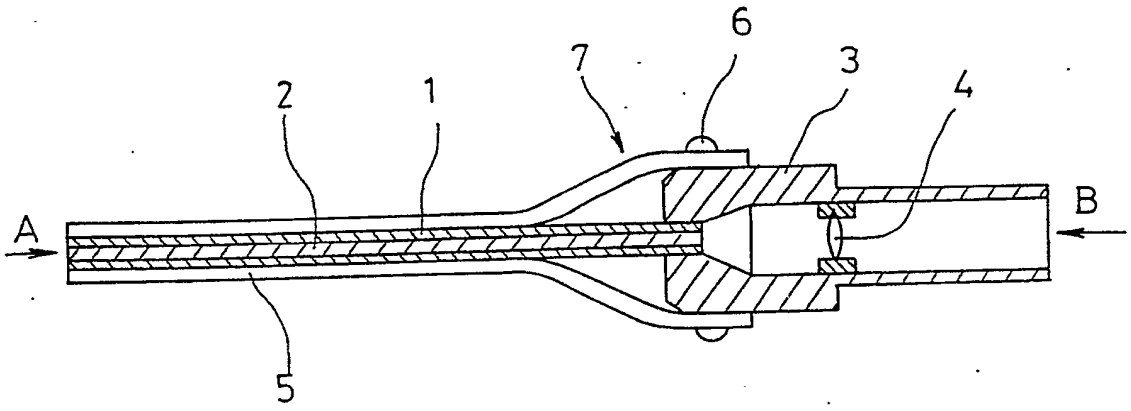

Fig. 4

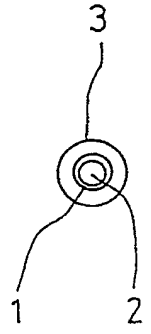

Fig. 5

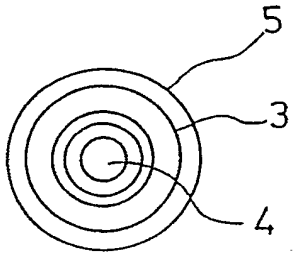

Fig. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 10 9798

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-4 148 550 (R.B. MACANALLY) * abstract; figures 1,2 *	1,4	G 02 B 23/26 A 61 B 1/00
A	US-A-4 281 929 (LORD et al.) * figures 1,5,6; column 3, lines 14-28 *	1-5	
A	WO-A-8 605 964 (BAXTER TRAVENOL LABORATORIES) * page 10, line 16 - page 11, line 8; figures 2,3,5 *	1,2,4,5	
A	US-A-4 921 326 (WILD et al.) * column 3, line 1 - column 4, line 23; figures 1-3 *	1,2,5	
P,X	EP-A-0 416 371 (RICHARD WOLF GMBH) * abstract; figures 1,2 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

G 02 B
A 61 B

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
Berlin	19 September 91	VON MOERS F

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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